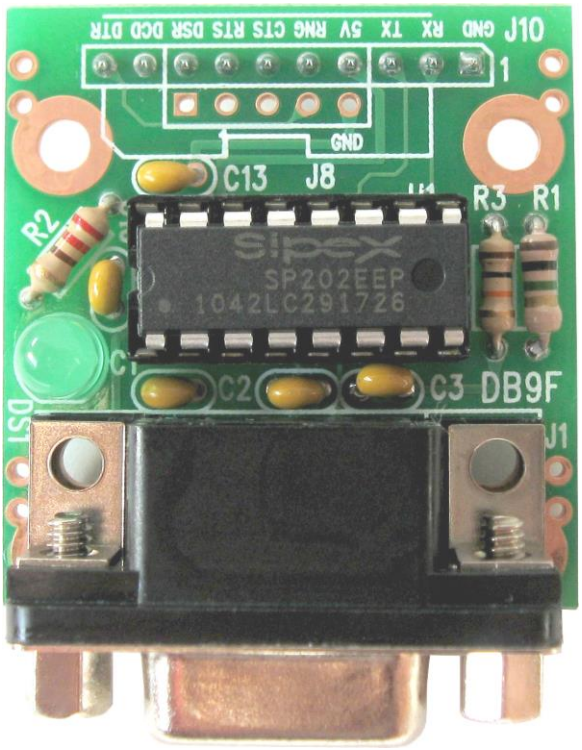
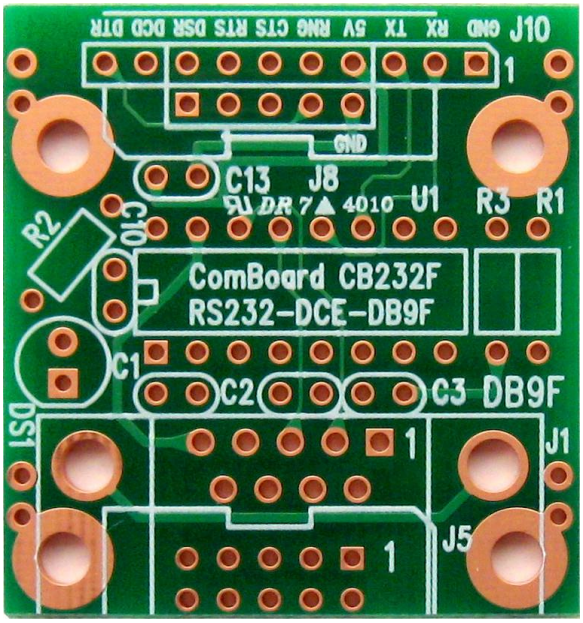
PCB-CB-232F

RS-232 to Logic Level Adapter with DB9F Connector and Power LED





Part Number: **PCB-CB-232F (unpopulated PCB, no parts)**

Features

- RS-232 to logic level adapter with DB9F connector (DCE style) and power LED. Two transmit and two receive drivers provided (Tx, Rx, RTS, and CTS signals).
- ComBoard standard pinout for interchangeable serial interface modules. 1x10, 2x5, or 1x4 header options available. Build with 1x10 male header for use with solderless breadboards.
- Bare PCB only (unpopulated, no parts provided). BOM and schematic available for download.
- All thru-hole construction allows for easy assembly. Using a DIP IC socket provides easy IC replacement.
- Double-sided, FR4 glass-epoxy PCB, 1oz/ft2 copper, anti-tarnish coating. Soldermask & silkscreen. Lead free and RoHS compatible.
- DB9 connector can be replaced with a 2x5 shrouded header for use with ribbon cable connectors.

Details

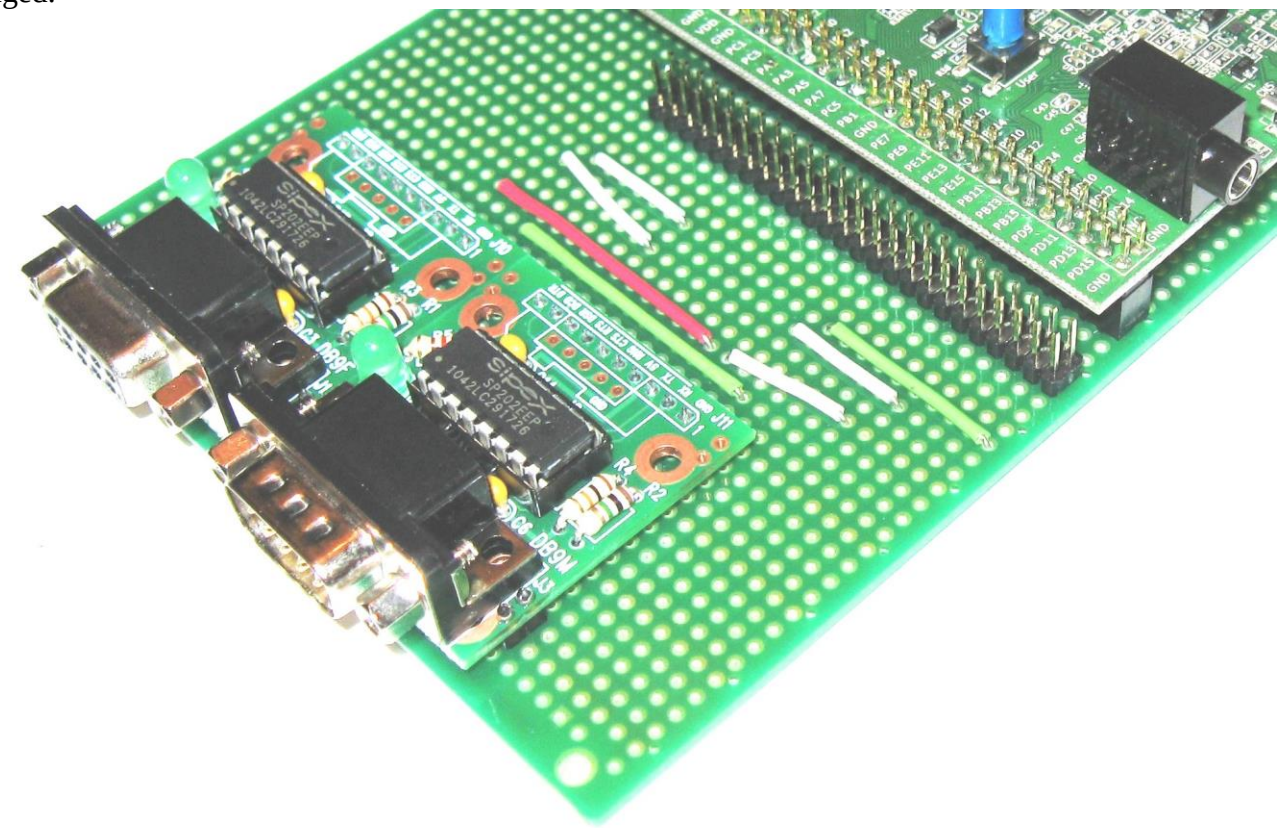
The PCB-CB-232F is a bare PCB to build the CB-232F logic-level to RS-232 adapter. This is an unpopulated board and no parts are included. The BOM (bill of materials) and schematic diagram are available at **http://www.busboard.us/products/PCB-CB-232F/** to construct the circuit. Soldering is required and prior experience with electronic assembly is recommended. A PCB soldermask helps prevent solder bridges on tracks and a silkscreen legend provides part locations.

The CB-232F provides a DCE RS-232 serial port with a DB9 female connector. Drivers are provided for the Tx, Rx, RTS, and CTS lines with the other port lines unconnected. All thru-hole construction allows for easy assembly, maintenance, and modification. A DIP IC socket can be used to allow easy IC replacement to use different voltage/feature parts or to replace damaged parts.

The CB-232F uses the ComBoard standard for interchangeable serial interface modules. Various build options are possible including 4-wire serial, 1x10-pin female ComBoard header, or a 2x5-pin shrouded header for use with ribbon cables. With the 1x10 male header option, the CB232x can be used with solderless breadboards. The 0.1" spacing of parts and mounting holes allow it to be soldered onto prototyping boards. It can be plugged into microcontroller dev boards with ComBoard serial port headers allow the serial port type to be easily changed.

A power LED provides a visual indication of power status.

It can be used with several different RS-232 converter ICs using the MAX202 or MAX3232 16-pin DIP pinout. The Exar SP3232ECP-L is recommended to support both 3V and 5V operation, and it provides ESD protection. We recommend you use a socket for the driver IC so it can be easily replaced if they are damaged.



ComBoard Modules Soldered on a ProtoBoard

What is ComBoard?

ComBoard is an open standard for USART peripheral modules that can provide all 9 pins of the serial handshaking signals (8 signals plus ground). Many modules only need 2 signals (Receive and Transmit) or 4 signals (adding RTS and CTS flow control). However, it is helpful to have all the signals available on a development board for the modules that need them. The CB-232F module only uses Tx, Rx, RTS, and CTS.

A tenth signal is added to the connector, which is power for the module. Either +5V or +3.3V is used depending on the module and the microcontroller requirements.

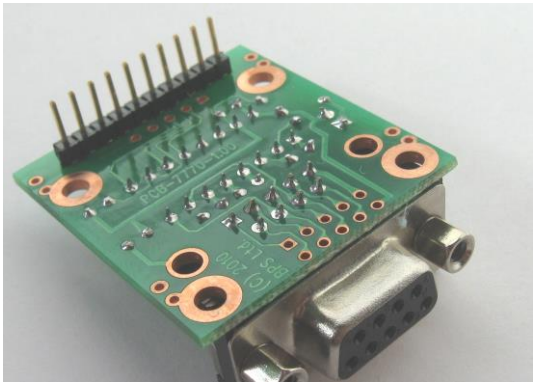
Various connectors can be used with ComBoard depending on the application.

ComBoard Connector Style	Key Application
1 x 10 Header Pins on Bottom	Plugs into solderless breadboards and development boards. All signals available.
1 x 4 Wired Connector	Simple wired modules only needing Tx and Rx.
2 x 5 Ribbon Cable Header	Ribbon cable connected modules with polarized (shrouded) connectors. All signals available.

The ComBoard 1x10 header style can be inserted into solderless breadboards or soldered into prototyping boards. Serial adapters with dual row headers can't be used with breadboards.

1x10 Header (J10), UART Logic Levels

The 1x10 header is usually installed on the bottom of the PCB to allow the adapter to be inserted in a breadboard or development board, or soldered into a prototyping board.



The ComBoard 1x10 pinout is as follows:

Pin	Name	Description	Signal Direction
1	GND	Ground	
2	Rx	Receive Data	Input (to MCU)
3	Tx	Transmit Data	Output (from MCU)
4	+5V (or +3.3V)	Power	Power to ComBoard
5	Ring	Ring	Input (to MCU)
6	CTS	Clear To Send	Input (to MCU)
7	RTS	Request To Send	Output (from MCU)
8	DSR	Data Set Ready	Input (to MCU)
9	DCD	Data Carrier Detect	Input (to MCU)
10	DTR	Data Terminal Ready	Output (from MCU)

The DTE names are used for logic-level signals (Tx is an output).
All signal levels on this header are CMOS logic levels. MCU = the microcontroller.

Pins 5,8,9,10 Not Used on CB-232x modules.

The ComBoard 1x10 pin out provides all 9 pins required for full serial port handshaking plus a power pin. Some modules may only use some of the pins, such as Tx and Rx for 2-wire serial, or Tx, Rx, RTS and CTS for 4-wire serial with flow control.

The power supplied on pin 4 is +5V or +3.3V depending on the development board and jumper options.

The CB485, CB-232F and CB-232M modules use the same 1x10 connector signals so that they can be plugged in interchangeably on development boards. Note that DTE signals names and directions are used on the 1x10 connector regardless of whether the module and DB9 connector is DTE (DB9M) or DCE (DB9F).

Alternative: Wired 1x4 Connector (J10 pins 1-4), UART Logic Levels

To reduce the number of wires required for applications requiring Rx and Tx only, a 4-pin connector can be installed in instead of the 10-pin. Power and ground for the interface circuitry are provided.

J10 uses only pins 1 to 4 of the standard ComBoard signals as follows:

Pin	Name	Description	Signal Direction
1	GND	Ground	
2	Rx	Receive Data	Input (to MCU)
3	Tx	Transmit Data	Output (from MCU)
4	+5V (or +3.3V)	Power	Power to ComBoard

We recommend using polarized connectors when using wired cables to connect to modules to avoid reversed connections. The connector 0.1" pin pitch is compatible with Tyco MTA-100 polarized headers, Molex KK polarized headers, Molex SL series latching connectors, and many others.

Alternative: 2x5 Header (J8), UART Logic Levels

The ComBoard 2x5 header is an alternative pinout that allows the serial port to be used with 10-pin ribbon cables. This can be useful to interface to another board or to locate the serial driver away from the main board.

The ComBoard 2x5 pin out is as follows:

Direction	Signal Function	Pin	Pin	Signal Function	Direction
Input (to MCU)	DCD Data Carrier Detect	1	2	DSR Data Set Ready	Input(to MCU)
Input (to MCU)	Rx, Receive Data	3	4	RTS Request To Send	Output(from MCU)
Output (from MCU)	Tx, Transmit Data	5	6	CTS Clear To Send	Input(to MCU)
Output(from MCU)	DTR Data Terminal Ready	7	8	RING	Input (to MCU)
	GND Ground	9	10	+5V (or +3.3V)	Output

MCU = the microcontroller
All signal levels on this header are CMOS logic levels.
Pins 1,2,7,8 Not Used on CB-232x modules.

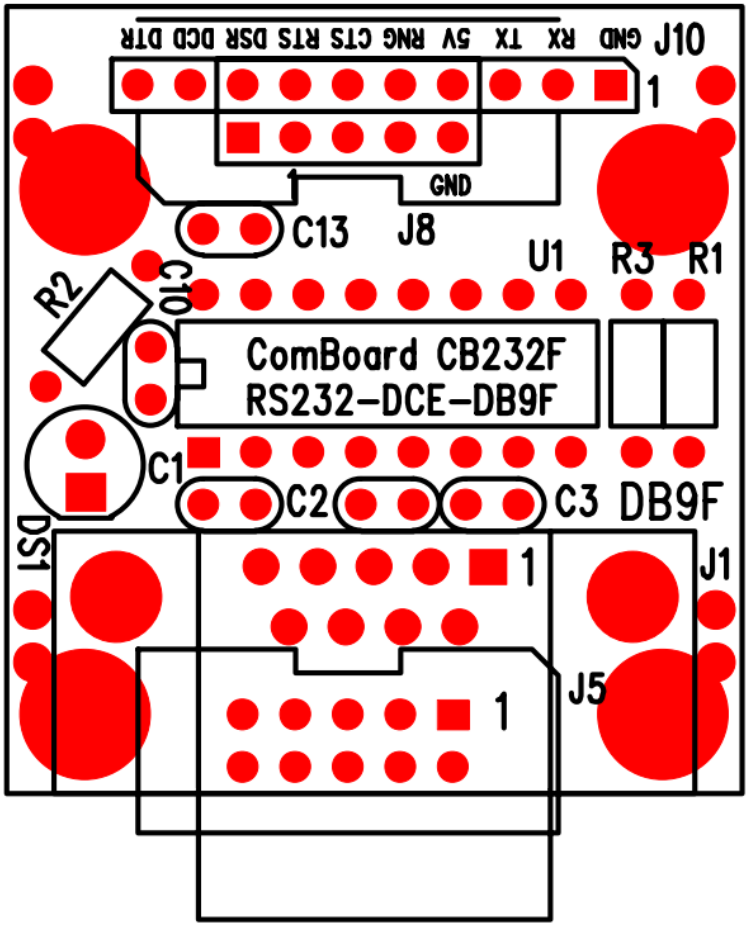
Polarized (shrouded) 2x5 headers should be used with polarized IDC ribbon cable plugs to avoid reversed connections.

2x5 Pinout Details

The ComBoard 2x5 pin order is designed to match the pin order of DB9 insulation displacement (IDC) ribbon cable connector. It is designed so that the serial signals are on the correct DB9 pins when a 2x5 to IDC DB9 ribbon cable is used. This is helpful on the RS232 side of the interface where a 2x5 to DB9 ribbon cable may be used, and the same signal order is used on the logic side to help keep the signals organized.

Note1: One side of the 2x5 connector overlaps and shares 5 pins with the 1x10 ComBoard connector which saves PCB space.

Note2: The ComBoard 2x5 pinout is different from the Olimex UEXT standard, which also uses 10-pin ribbon cables. ComBoard has all 9 serial signals plus power. UEXT connector serial signals only have the Tx, Rx, power, and ground.



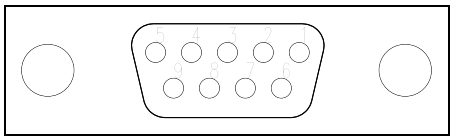
PCB Component Locations

DB9F (DCE) Connector (J1), RS232 Levels

DTE devices use a DB9 male connector while DCE devices use a female connector. Some equipment does not follow this convention.

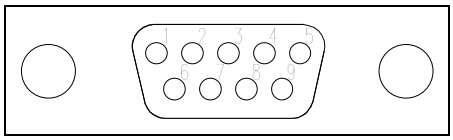
The DB9 connector can be replaced with a 2x5 shrouded header for use with ribbon cable connectors.

The CB-232F adapter uses a DB9 female connector.



DB-9 Female Connector Pin Numbers
For DCE Devices

It connects DB9 male connector. Note that pin 1 is on the opposite side.



DB-9 Male Connector Pin Numbers
For DTE Devices

The signals on the pins are shown in the table below.
Note that the signal names for a pin are the same for both DTE and DCE connectors. For example, TX is an output on the DTE connector and an input on the DCE connector.

DTE (Computer), Male			DCE (modem), Female		
Signal Name	Pin Number	Direction	Signal Name	Pin Number	Active State Logic / RS232
DCD	1	<<	DCD	1	LO / SPACE (+)
RX	2	<<	RX	2	HI / MARK (-)
TX	3	>>	TX	3	HI / MARK (-)
DTR	4	>>	DTR	4	LO / SPACE (+)
GND	5	--	GND	5	-
DSR	6	<<	DSR	6	LO / SPACE (+)
RTS	7	>>	RTS	7	LO / SPACE (+)
CTS	8	<<	CTS	8	LO / SPACE (+)
RING	9	<<	RING	9	LO / SPACE (+)

Table 1 - RS-232 DB-9 Connector Signals

DTE = Data Terminal Equipment
DCE = Data Communications Equipment
Traditionally a DTE device would be a terminal with a screen and keyboard, or a PC computer.
A DCE device would have been a modem.
With microcontroller projects, the terms are less obvious because the microcontroller may be the master (the terminal) or the slave communications device, or communicating with a peer. However, we keep the terminology because the RS232 standard is well established.

RS-232 Signal Levels

The reason a RS-232 interface IC is needed is to convert the 0 and 5 Volt logic levels (or 0 and 3.3V) to the positive and negative RS-232 levels. The RS-232 voltages were selected in the days of teleprinters to help transit data reliably over long lengths of cable.

The RS-232 interface converts the conventional 0 to 5 volt signal range (Low/High signals) into two states called Mark and Space.

> Mark is used for the negative state which is from -5 to -15 volts.
> It represents a logical 1 (a High signal).
>
> Space is used for the positive state which is from +5 to +15 volts.
> It represents a logical 0 (a Low signal).

The RS-232 driver also inverts the signal so that a +5V signal is converted to the negative RS-232 (Marking) state. In Figure 2 below, the upper signal is the logic-level serial data going into the interface IC, and the lower signal is the RS-232 level signals coming out.

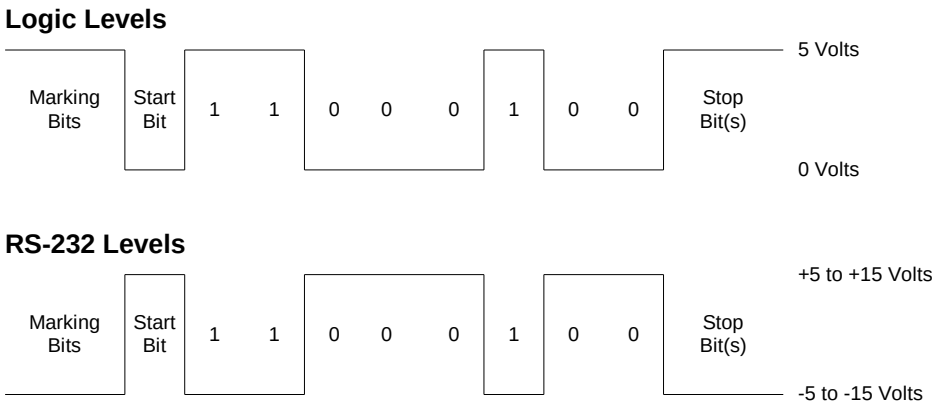


Figure 2 RS-232 Signal Levels

RS-232 Data Format

Figure 2 shows the transmit line voltages for an 8 bit word being sent with no parity. The signal is Marking (logic HI) when no data is being sent.

When a character is transmitted, it begins with a Start Bit which is a Space. It is followed by the 8 bits of the character. The least significant bit (LSB) is sent first and the most significant bit (MSB) of the character is sent last. Finally, Stop Bit (a Mark) is sent at the end of the character. If parity is used, a parity bit is added before the Stop Bit.

Figure 2 shows the binary value 00100011 being sent, which is Hex 0x23, decimal 35, which is the '#' octothorpe character.

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